Space Weather Technical Forecast

Issued on Sunday, 13 November 2022 at 13:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares (R1-R2/Minor to Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity over the past 24 hours has reduced to Low. There was a period of more enhanced C-class activity between 12/1400-2000 UTC, culminating in C6 flare at 12/1804 UTC, this from AR3141.

There are currently four numbered sunspot regions on the visible disc and one unnumbered region. AR3141 remains the largest and most significant region, although has decreased in overall size through the period. AR3140 has shown slow development on its southern flank with more prominent small umbrae developing. AR3145 to the east of AR3140, continues weak with just several small spots. The region in the northeast continues its slow development, with several weak, small spots and has been designated AR3146. Meanwhile a new Axx/Alpha region has emerged in the northern hemisphere approaching the centre disc.

No Earth-directed CMEs (Coronal Mass Ejections) have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, saw a gradual, albeit erratic decrease during the period from around 460-500km/s, to around 430-460km/s, as the effects from a recent coronal hole high-speed stream started to wane. Density has mainly been at average levels, with a declining trend. Total magnetic field strength (IMF) initially increased to peaked at 13 nT (moderate) near the start of the period, before tapering off to a steady 6 nT weak) by the end. The north-south component, Bz, has fluctuated between +7/-5 nT, with mostly positive Bz in the first half of the period, then mostly negative from around 13/0000 UTC. Phi angle has been largely negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2) throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 has been at background to moderate levels, with a peak of 158 pfu at 13/0050 UTC. Electron fluence levels remained well below Active levels with a sharp decline, then steady trend during the period. Observed fluence at 13/0001 UTC was 1.87e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be generally Low, with a chance of further isolated M-Class flare activity. The most likely source of activity is from the largest and most complex region AR3141, and also AR3140.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently forecast. Although some faint ejecta, perhaps associated with occasional flare activity over the past couple of days, cannot completely be discounted as having some Earth directed trajectory. However, any potential impacts would be expected to be weak.

Solar winds are currently at slightly elevated levels, due to ongoing, but waning coronal hole

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influences. Winds are expected to return towards slow-ambient levels over the next couple of days as the HSS effects wane. CH45 and/or CH44 will rotate into a potentially geoeffective position by day 3 (15 November), and may give a weak enhancement to solar winds, although confidence is low as these are not recurrent features. However, enlil model forecasts do hint that this is a possibility.

Geomagnetic activity is expected to be predominantly Quiet to Unsettled through the period, perhaps with a slight chance of isolated Active intervals around day 3 (15 November).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is expected to remain at background levels. However, there is a very slight chance of an increase in solar radiation storms over normal conditions given the presence of two moderately large, complex sunspot regions in the western hemisphere. Electron flux is forecast to be at background to moderate levels throughout the period. Fluence values are expected to remain below or well below Active throughout the period.

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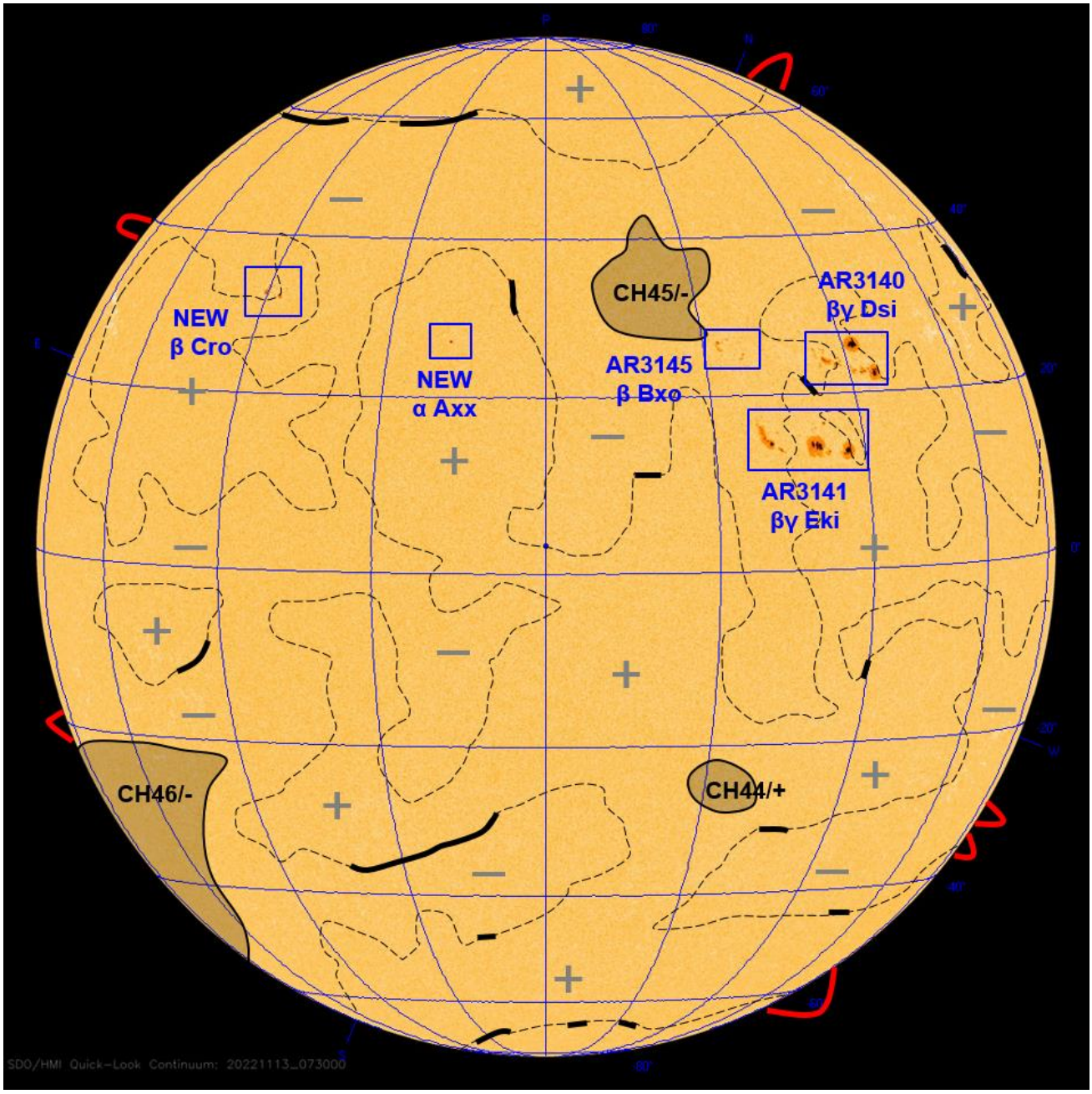
Figure 1. Solar Analysis Valid 13/0730 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are currently forecast. Although some faint ejecta, perhaps associated with occasional flare activity over the past couple of days, cannot completely be discounted as having some Earth directed trajectory, any potential impacts would be expected to be weak.

Solar winds are currently at slightly elevated levels, due to ongoing, but waning coronal hole influences. Winds are expected to return towards slow-ambient levels over the next couple of days as HSS effects wane. There are three coronal holes on the visible disc. CH45 now just in the northwest quadrant and CH44 in the southwest are both small, non-recurrent features. CH45 and CH44 will rotate into a potentially geoeffective position by day 3 (15 November), and may give a weak enhancement to solar winds, although confidence is low given these are not recurrent features. However, enlil model forecasts do hint that this is a possibility. CH46 in the far southeast is a recurrent feature, but currently falls outside the forecast period to become geo-effective.

Geomagnetic activity is expected to be predominantly Quiet to Unsettled through the period, perhaps with a slight chance of isolated Active intervals around day 3 (15 November).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections – None expected

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Radio Blackouts - X-Ray Flares:

Solar activity is expected to be generally Low, with a chance of further isolated M-Class flares. The most likely source of activity is from the largest and most complex region AR3141 Eki/Beta-Gamma, and also AR3140 Dsi/Beta-Gamma. Two potential returning regions are due to cross the eastern limb over the coming days and these regions may additionally contribute to the overall flare risk.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: HMI-Intensitygram and HMI-Colorized Magnetogram imagery of AR3040 ~13/1200 UTC.

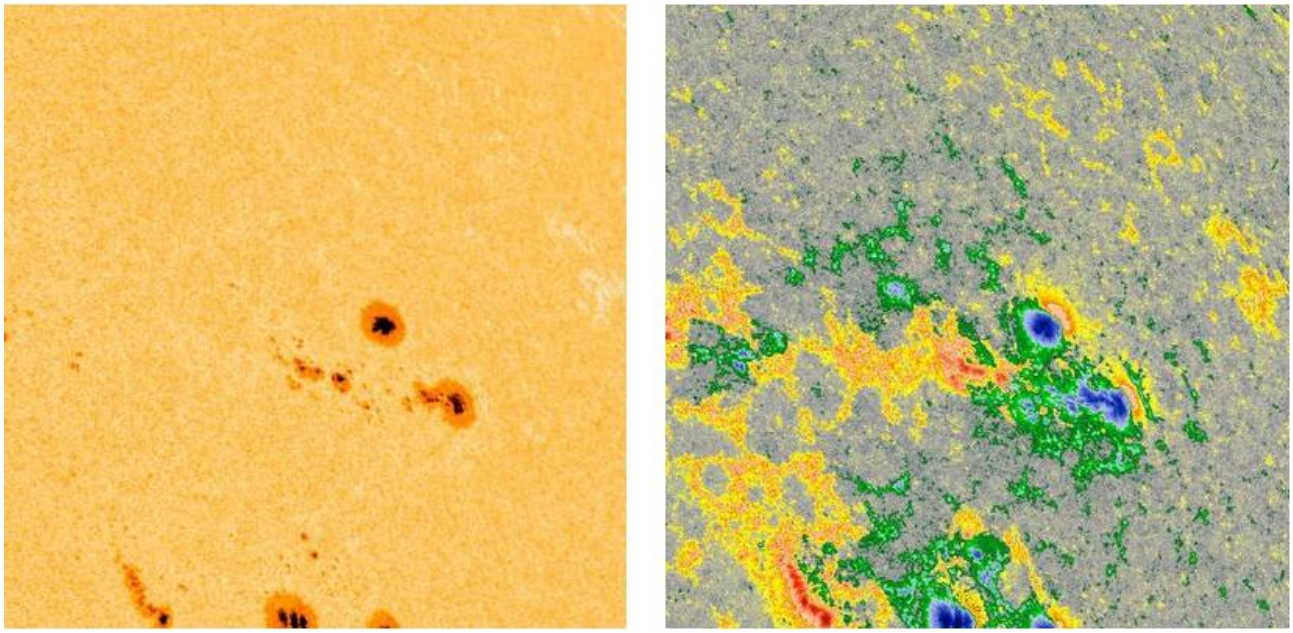

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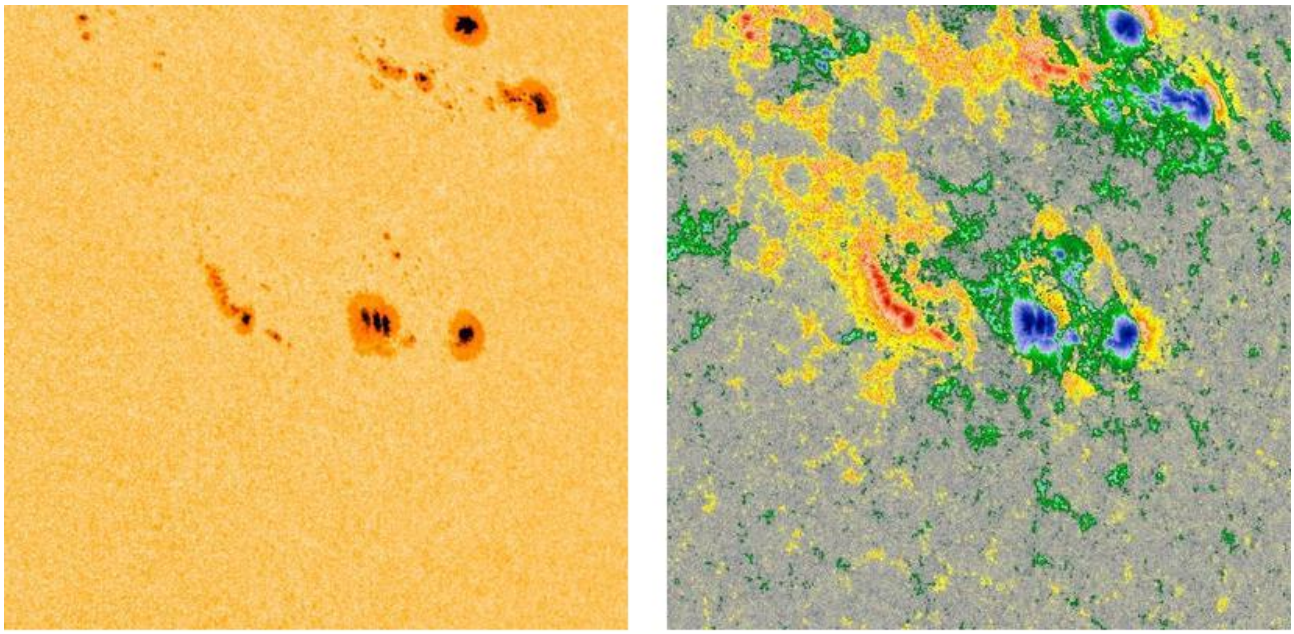
Figure 3: HMI-Intensitygram and HMI-Colorized Magnetogram imagery of AR3041 ~13/1200 UTC.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at Background levels and is forecast to remain at this level throughout the period. As AR3141 and AR3140 transit across the western solar hemisphere there is a slightly increased risk of proton storms over background conditions.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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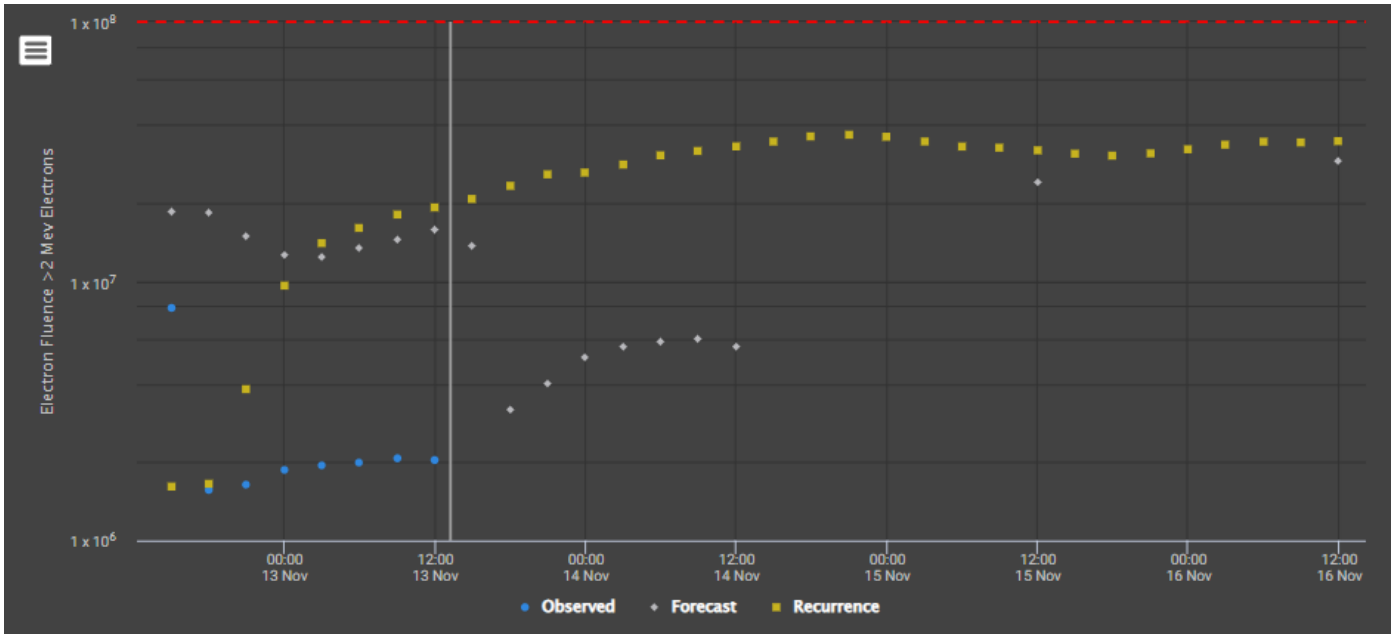
High Energy Electrons Event (≥ 2MeV):

Electron flux (greater than 2MeV) is currently at Background to Moderate levels. Electron flux is forecast to remain at predominantly Background to Moderate levels through the period.

Electron fluence values are well below the Active (1e8 integrated pfu) threshold and are expected to remain so throughout the period, with a largely flat trend most probable. The MOSWOC REF Model currently supports electron fluence values remaining below the 1e8 Active threshold, however, model confidence in absolute values is low.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM output. Observed currently running below Forecast values and expected to remain so through the period. Fluence very likely to stay below the Active threshold.



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